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Analysis the Hydrological Situation of the Influx Runoff Series for Poyang Lake

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Abstract

According to historical observed data for the runoff into the Poyang Lake, the analysis of runoff into the Poyang Lake about 50 years was conducted. The results showed that the five rivers runoff for the influx into the Poyang Lake, were decreased since 2002, and the runoff decline phenomenon like this has appeared in the 60's and 80's. About the runoff annual distribution, the uneven distribution was detected. The sum of the monthly runoff from April to July account for 46%~69% about the entire year, and in the dry season, the sum of the monthly runoff from October to next year January only account for 12%~23%. About the each monthly runoff series of the five rivers from 1956 to 2008, it was observed that during the flood season the dispersion coefficient of the series is small, and in the non-flood season the dispersion coefficient of the series is bigger. It illuminated that the monthly runoff series were changer in the non-flood than the flood season and the increased human activities may be the major factor.

Keywords: climate change, human activities, runoff

In recent years, with the global climate change and human activities exacerbate the effects of uneven spatial and temporal distribution of water resources is increasing. In the south wet area, the phenomenon was the main factors which constrained to local economic development. Hydrological analysis of the runoff situation is the foundation of the optimal water resources allocation and ecological water management. In Poyang Lake region, there are rich about natural resources and biodiversity, on the other hand its Hydrological analysis is complex. The Poyang region is lake with high water level, while with the low water level, the Poyang region is a trench area. The phenomenon mostly depends on the influx runoff. The hydrological analysis of influx runoff will help to understand the water cycle laws and characteristics of water resources. All of this will contribute to the rational development and utilization of water resource for the Poyang Lake.

Overview

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Poyang Lake Basin is located at latitude 24 ° 29'14 "~ 30 ° 04'41", longitude 113 ° 34'36 "~ to 118 ° 28'58 ", and the area is about 162,200 km^2. The site is in a typical East Asian monsoon region with mild climate, abundant rainfall. The mean annual precipitation is about 1700 mm and mean annual evaporation from a free water surface is 800 ~ 1 200 mm.

The Poyang Lake Basin is on the Middle and Lower Yangtze River and has 5 sub-catchments from east to west (Fig.1), named Raohe River, Xinjiang River, Fuhe River, Ganjiang River, Xiushui River. Each sub-catchment has corresponding river. The sum of the influx Poyang Lake about 5 rivers is a major component of the lake influx, and the proportion is about 82% of the whole. The runoff of the 5 rivers is estimated by the runoff control hydrological stations adjacent the Poyang Lake(Fig. 1). The runoff, sub-catchment area, and other statistics characteristics of the 5 rivers is showed on the table 1.

Figure 1 Distribution of the 5 rivers and hydrological stations

Table 1 The statistics characteristics of the 5 rivers

River name	Hydrologic station	Catchment's area	River length	Annual runoff
		(km^2)	km	(10^8 m^3)
Ganjiang River	Waizhou	80948	751	678.9
Fuhe River	Lijiadu	15811	349	126.2
Xinjiang River	Meigang	15535	312	177.5
Raohe River	Hushan	6374	313	70.8
	Dufengken	5013	250	46.2
Xiushui River	Qiujin	9914		88.4
	Wanjiabu	3548	148	35.2

The Ganjiang River is the largest river for the 5 river in the catchment's area with the catchment's area 80948km^2, and accounted for 59% of the whole. The average yearly runoff is estimated to be 678.9×10^8 m^3 between 1956 and 2000. With the other rivers runoff descending order, the Xinjiang River (177.5×10^8 m^3), Fuhe River (126.2×10^8 m^3), Xiushui River (123.6×10^8 m^3), and Raohe River (117×10^8 m^3) has variability of runoff.

The yearly runoff changes of the 5 rivers during the last 50 years

The runoff analysis of the 5 rivers in the different ages. The rapid increase of human population, the expansion of cultivated land, the development and expansion of irrigation practices and the construction of reservoirs can affect the yearly runoff during the 1956~2008. With the different ages, the average yearly runoff of the 5 rivers tends to fluctuate from period to period (table 2).

Table 2 The average runoff of the 5 rivers in the different ages unit: 10^8 m^3

River name		Ganjiang River	Fuhe River	Xinjiang River	Raohe River		Xiushui River	
Hydrologic station		Waizhou	Lijiadu	Meigang	Hushan	Dufengken	Qiujin	Wanjiabu
The average runoff in different years	1956～1959	580	128	149	65	46	69	28
	1960～1969	616	118	158	59	35	72	29
	1970～1979	709	127	180	73	47	91	36
	1980～1989	658	126	171	67	46	84	34
	1990～1999	773	135	214	91	60	112	45
	2000～2008	659	105	161	57	34	76	29
Average	1956～2000	679	126	178	71	46	88	35

According as the ages, the time series about 1956~2008 are divided into 6 stages. The runoff has shown an abundant and dry trend with fluctuations. From the historical process, in the 50s', 80' and starting in the 21th century, the runoff of most of the rivers are relatively dry, and in the 70s' and 90s' the runoff relatively abundant. Since the beginning of this century, compared to the average for many years the runoff of the 5 rivers are reduced. The runoff decrease of maximum is the Raohe River, and the runoff reduction is 26×10^8 m^3, proportion about 22.2%. Followed by the Fuhe River, the runoff reduction is 21×10^8 m^3, proportion about 16.7%. The runoff decrease of minimum is the Xinjiang River, with runoff reduction 17×10^8 m^3, proportion about 9%. From the river runoff anomaly map in different periods (Fig. 2), the reduction phenomenon is obvious, and the amount of the runoff reduction is about 20×10^8 m^3.

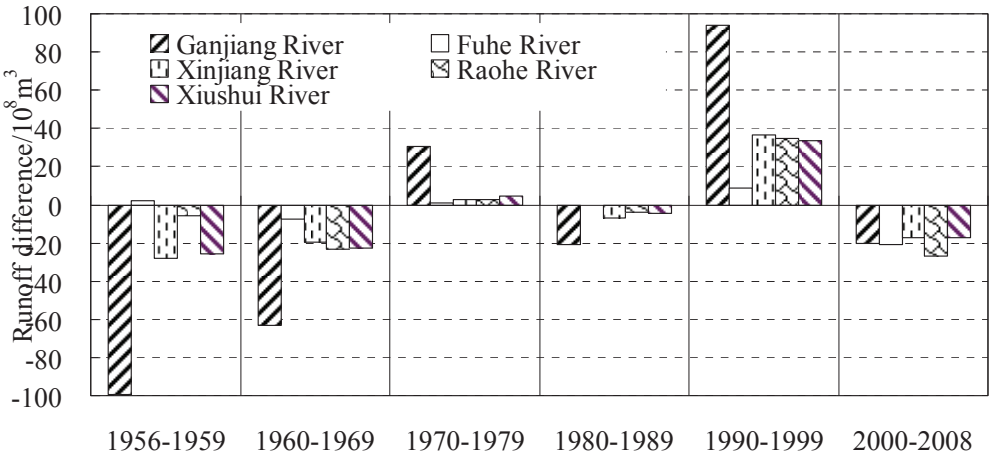

Figure 2 The runoff anomaly map of the 5 rivers in different periods

The high and low runoff cycles analysis of the 5 rivers. In recent years, with the climate change and the impact of human activities, the runoff of the 5 river, has reduced. Compared with the average for many years, the value of the runoff reduction from 2002 to 2008 year is about 4.3% ~ 22.1%. The runoff of the Raohe River drastically decreased about 22.1%, while the ruction of the Ganjiang Rivera is relatively small. The high and low runoff cycles can analyze from the difference accumulation curve which the difference between the each yearly runoff and the series average yearly runoff is accumulated.

Figure 3 shows from the 1956 to 2008, the difference runoff accumulation curve of the 5 rivers into the Poyan Lake. It can be seen from the figure, there are three time rang which is 1962～1968,1984～1991 years and 2002～2008 years, have been continuing decline duration about 7,8 and 7 years. From the duration of the dry and the average the runoff value, the dry state of the phase about the 1962～1968 is more serious than of the phase about the 2002～2008, so it is hard to say that the phenomena of the runoff reduction in recent years is outside the high and low runoff cycles.

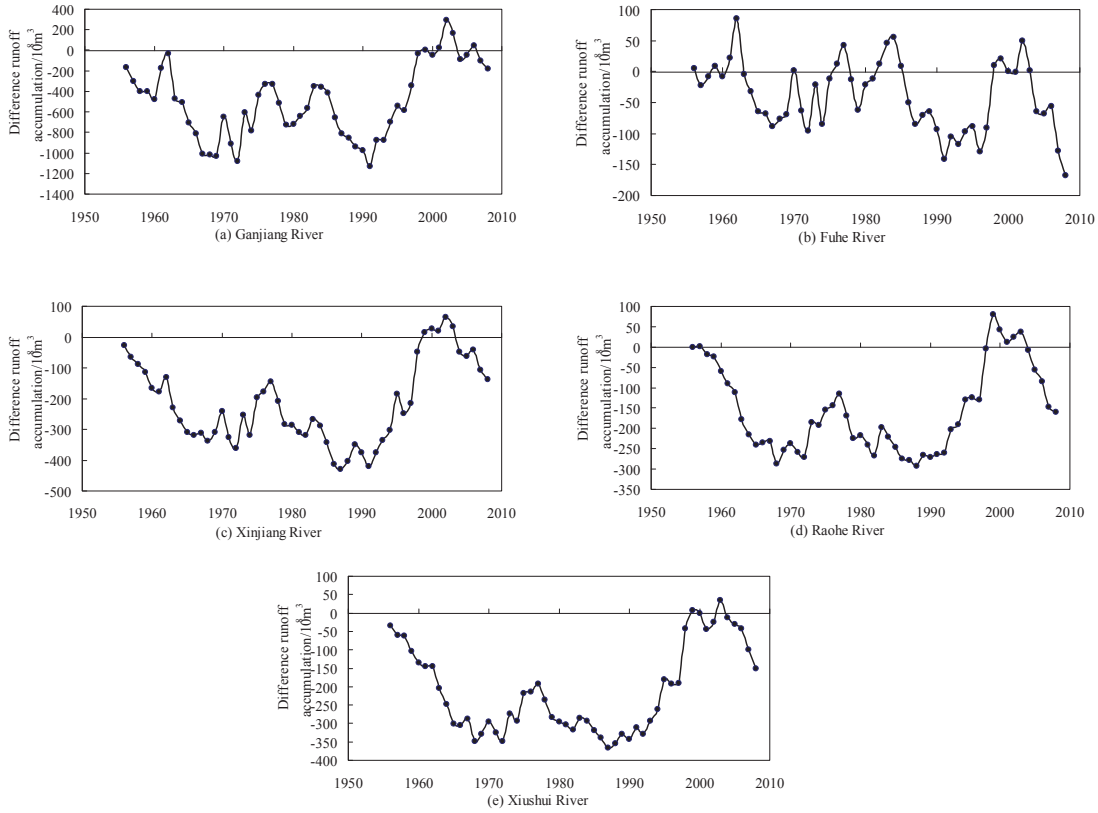

Figure 3 The difference runoff accumulation curve of the 5 rivers from 1956 to 2008

Monthly runoff changes of the 5 rivers

The annual runoff distribution of the 5 rivers. The annual runoff distribution of the 5 rivers is uneven (Table 3). The runoff summation during the flood phase is the larger proportion of total annual runoff, about the 63%～79%. In the flood phase, during the maximum of 4 consecutive months which are Apr., May, Jun. and Jul., the sum of the runoff accounts for the year 47～70%. In the 5 rivers, the maximum runoff summation belongs to the Raohe River while the minimum runoff summation belongs to the

Xiushui River. In the dry phase, during the minimum of 4 consecutive months which are Jan., Oct., Nov. and Dec., the sum of the runoff accounts for the year 12～23%. The minimum runoff summation belongs to the Xinjiang River, which the proportion is only about 12%.

Figure 4 shows the monthly runoff comparison about the 5 rivers. The Ganjiang River runoff was significantly higher than on other rivers, with the runoff distribution hump narrow. The phenomenon indicates the flood phase of Ganjiang River runoff alternates with periods of the dry, with the rapid increase of flood runoff and the quickly decline of dry runoff.

Table 3 the annual runoff distribution ratio of the 5 rivers **unit:%**

River name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ganjiang River	3%	4%	9%	14%	17%	18%	10%	7%	6%	4%	4%	3%
Fuhe River	3%	5%	10%	15%	18%	21%	10%	4%	3%	3%	3%	3%
Xinjiang River	3%	5%	10%	15%	17%	22%	10%	5%	4%	3%	3%	3%
Raohe River	2%	4%	9%	15%	18%	22%	15%	6%	3%	2%	2%	2%
Xiushui River	6%	5%	8%	10%	12%	12%	13%	9%	7%	5%	6%	6%

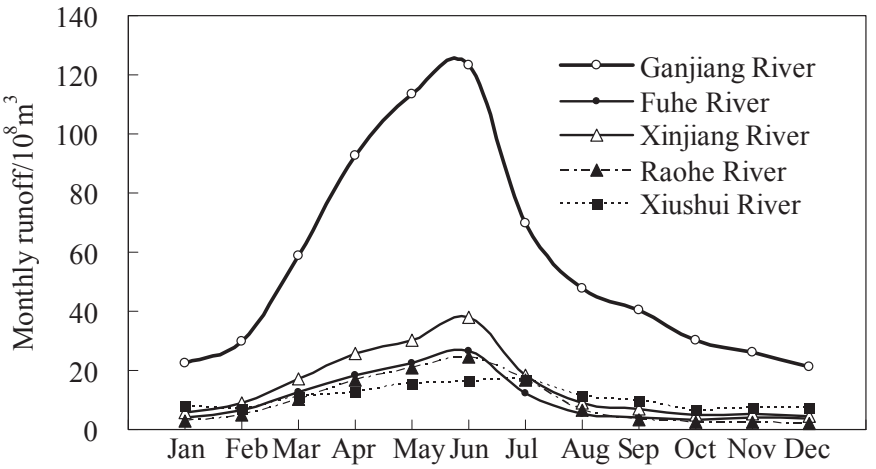

Figure 4 The Chart of annual runoff distribution about the 5 rivers

Monthly runoff changes from 1956 to 2008 year. The Dispersion coefficient is the ratio between the standard deviation the average value of data series. The parameter reflects the difference size between data and the average level. The greater the dispersion coefficient is, the more scattered data distribution is. On the contrary, the smaller the dispersion coefficient, indicated that the distribution of data around the average concentration.

Figure 5 shows the changes of the dispersion coefficient about the monthly runoff series from 1956 to 2008 year. It can be seen from the figure that in April the river runoff dispersion coefficient is on the minimum value about o.45. The phenomenon suggests that the variety of April runoff of the 5 rivers is weak from 1956 to 2008 year series. From July to December, the data points of the dispersion coefficient about the 5 rivers are scattered. In the 5 rivers, the value of coefficient about the Raohe River, Fuhe River and Xinjiang River are relatively bigger, while about Ganjiang River and Xiushui River are smaller. This phenomenon may be caused by the construction of water conservancy project, the regulation and storage of the reservoirs, water runoff process and water runoff trends.

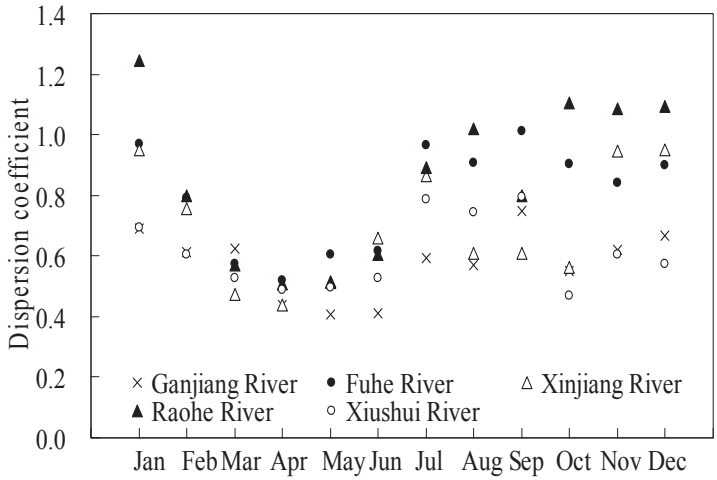

Figure 5 The monthly runoff dispersion coefficient comparison chart about the 5 rivers

Conclusions

The Poyang Lake have abundance water resources and rich biodiversity gave birth with the special climate and geographical conditions. In recent years, with the climate change and the impact of human activities, the runoff of the 5 river, has reduced. Compared with the average for many years, the value of the runoff reduction from 2002 to 2008 year is about 9.6% ~ 22.2%. The runoff of the Raohe River drastically decreased about 22.1%, while the ruction of the Ganjiang Rivera is relatively small. there are three time rang which is 1962～1968,1984～1991 years and 2002～2008 years, have been continuing decline duration about 7,8 and 7 years.

About the each monthly runoff series of the five rivers from 1956 to 2008, it was observed that during the flood season the dispersion coefficient of the series is small, and in the non-flood season the dispersion coefficient of the series is bigger. It illuminated that the monthly runoff series were changer in the non-flood than the flood season and the increased human activities may be the major factor.

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